The GAS
REFRIGERATOR

ELECTROLUX SERVEL CORP.


IMPERATOR CAESAR

1926

THE ELECTROLUX SERVEL CORPORATION MEETS THE LONG FELT NEED OF A REFRIGERATION LOAD IN THE GAS INDUSTRY WITH THE GAS-FIRED ABSORPTION TYPE REFRIGERATOR.

PATENTS GRANTED AND PENDING

GAS-FIRED REFRIGERATION A REALITY

THE production of a practical and salable gas-fired absorption type refrigerator by the Electrolux Servel Corporation marks the accomplishment of a development long sought by the gas industry.

The refrigerator has been in process of continuous and extended development for many years. The principles involved are ingenious. There has been no approach to them in the refrigeration industry. This refrigerator can truly be described as revolutionary. It maintains constant refrigeration without dependence on any mechanical means.

The refrigerator differs from all previous known types in that it dispenses with every kind of moving part, including motor, compressor, pump, fans, floats and even valves. In construction, it has the advantage that every part is fixed and rigid. There is nothing to get out of order. It is absolutely silent in operation.

Ammonia, hydrogen and distilled water are employed as fluids of refrigeration. The great advantage in the use of the substances of this group—which has never been used in any previous refrigerator—is that deterioration is impossible and, therefore, there is no limit to the life of the apparatus.

The apparatus works on the principle of "refrigeration by absorption." That means that the refrigerating agent is carried through a part of the cycle by an absorption liquid. Ammonia, for instance, absorbed by water is suitable as such an agent. The cycle of operation involves the releasing of the ammonia from the water by means of heat, after which the ammonia gas is liquefied by cooling it in a condenser. It is then made to evaporate at a low pressure and temperature in the evaporator whereby heat is absorbed from the surroundings. This is the real cause of the production of cold. The gaseous ammonia is again absorbed by the water from which it was exuded; the solution is again heated, and the ammonia repeats its cycle.

The refrigerating process in all absorption machines requires a reduction of the vapor pressure of the refrigerating agent as it passes from the liquefied to the gaseous state, and such lowering of the pressure has in all makes so far

known necessitated a valve or other throttling device, on one side of which a higher pressure prevails than on the other. In machines of continuous operation this means that some further mobile parts, such as pumping devices, etc., are needed to re-transfer the cooling agent from the low to the high pressure part of the apparatus. In the Electrolux Servel refrigerating apparatus, however, no moving parts are required as the *total* pressure is the same everywhere in the whole system. The indispensable drop in pressure of the cooling agent when entering the evaporator is obtained by the introduction of an inert gas, such as hydrogen. The presence of this gas produces a drop in the vapor pressure of the refrigerating agent, because, as the gases mix, the *partial* pressure of the refrigerating agent falls, whereby the process of evaporation takes place in the same manner as in ordinary absorption machines.

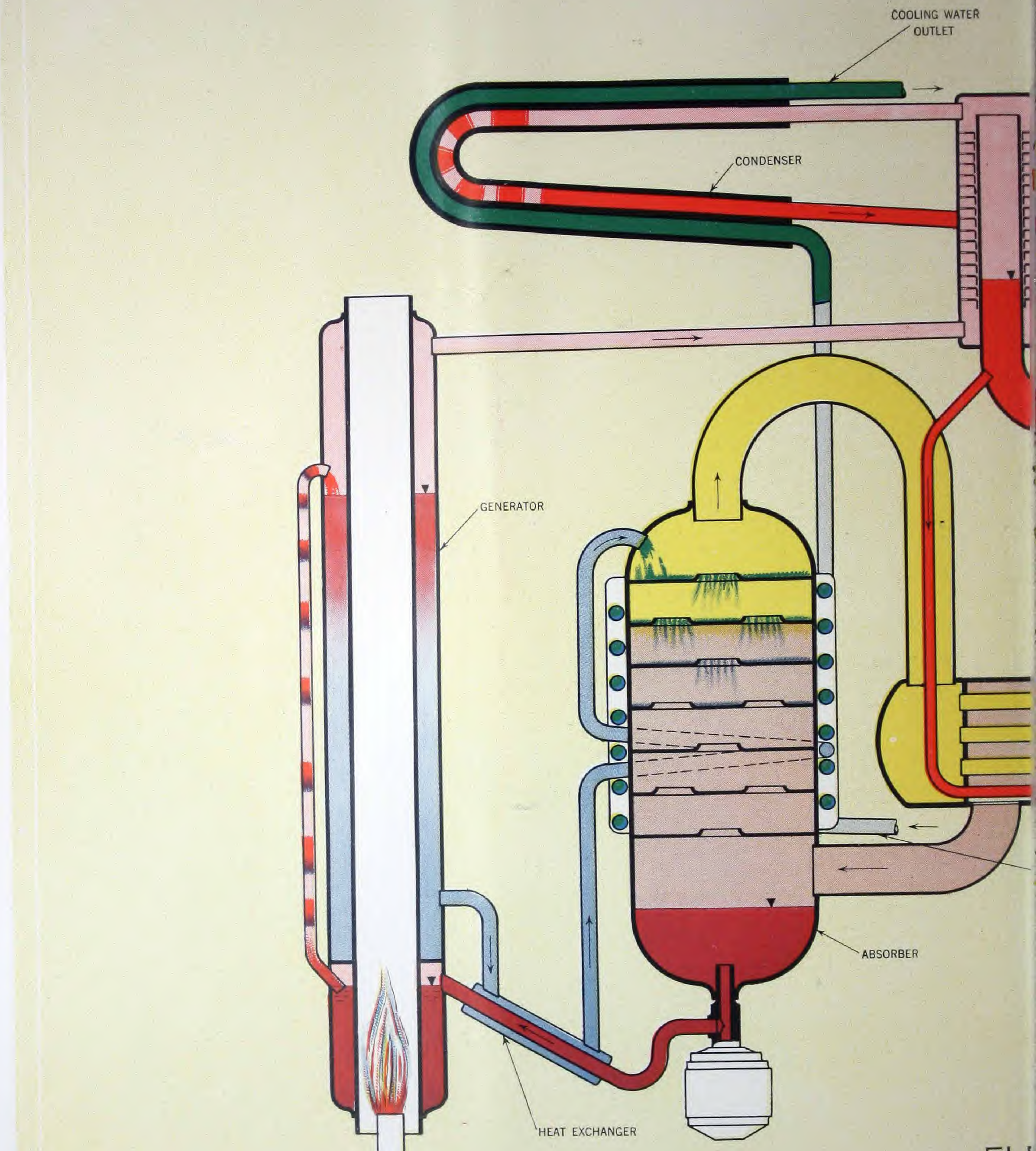
The result is the elimination of all moving parts and for the first time refrigeration is produced without mechanical means. While the construction is exceedingly simple, the various transformations and cycles of operation within the unit would probably appear highly complicated to the average person.

PROCESS OF REFRIGERATION

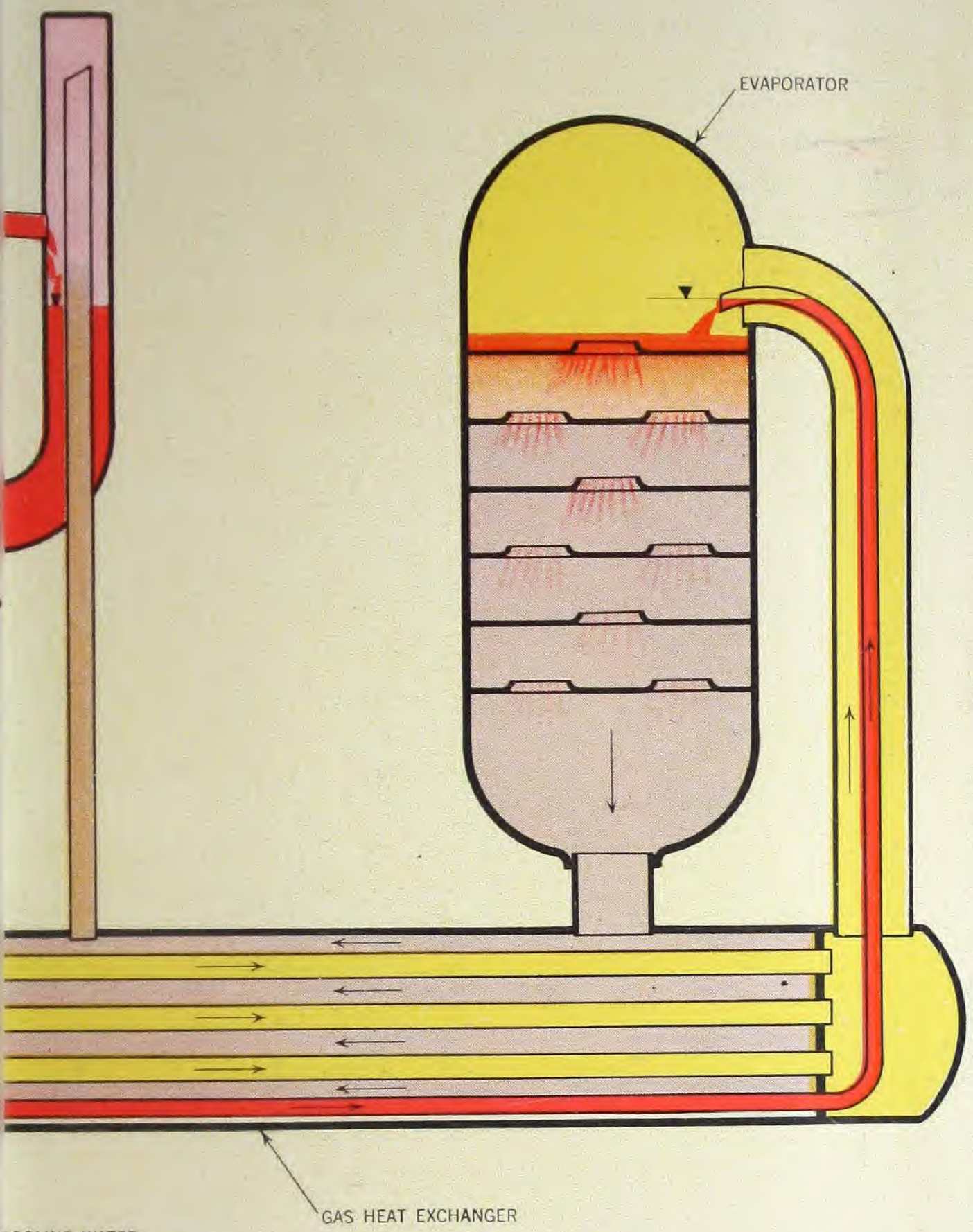
The process of refrigeration which follows may be studied in conjunction with the diagram on pages 6 and 7.

When the generator is heated, as mentioned above, the ammonia dissolved in the water evaporates, rises and passing through the rectifier, enters the condenser in which it is liquefied. Any admixture of water vapor is condensed and separated from the ammonia in the rectifier and flows back into the generator. The major part of the liquefied ammonia flows down through the condenser into the upper part of the evaporator. The remaining small part of the ammonia re-evaporates and returns to the rectifier.

In the evaporator, the ammonia is met by hydrogen, which is continuously transmitted from the absorber through a pipe inlet. The liquefied ammonia thereupon flows over a number of discs, placed inside the evaporator, where it evaporates in, and diffuses into, the hydrogen. The evaporation and mixing goes on until the ammonia vapor has reached the partial pressure in the mixture of gases, which corresponds to the existing conditions of temperature and pressure in the evaporator. As the ammonia thus diffuses into the hydrogen, its *partial* pressure falls, but the total pressure in the evaporator remains the same as in all other parts of the apparatus. The gas mixture, consisting partly of hydrogen and partly of ammonia, is of a higher specific gravity than pure hydrogen, and therefore sinks down through the evaporator.


COOLING WATER
OUTLET
CONDENSER
GENERATOR
ABSORBER
HEAT EXCHANGER

IFIER



STRONG LIQUID

WEAK LIQUID

AMMONIA GAS

HYDROGEN GAS

AMMONIA & HYDROGEN GAS

COOLING WATER

DIAGRAM OF

GAS-FIRED REFRIGERATOR

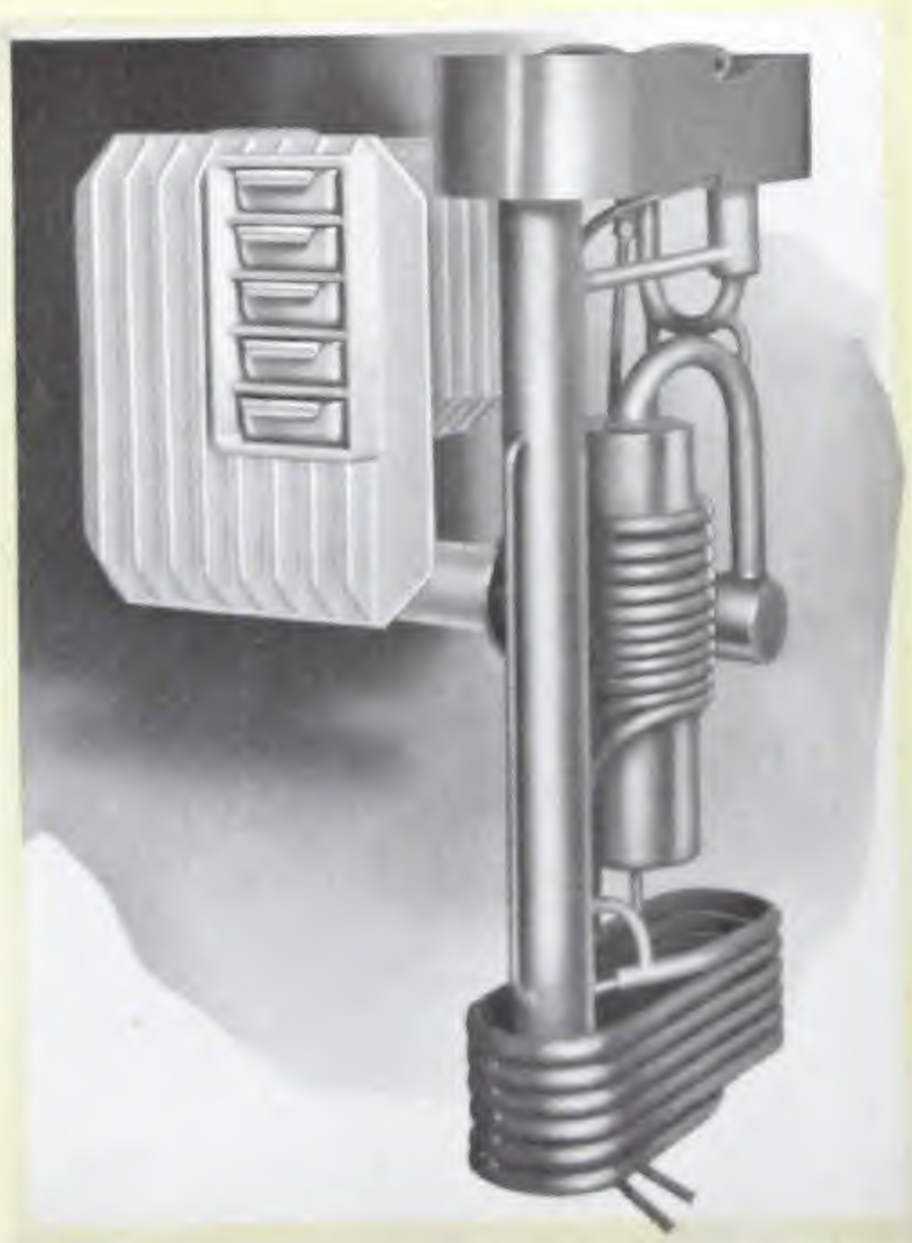
MANUFACTURED BY

TROLUX SERVEL CORPORATION

During the passage through the evaporator the heat-absorbing evaporation of the ammonia takes place, and accordingly heat is taken up from the surroundings through the walls of the evaporator.

From the bottom of the evaporator, the gas mixture flows through a pipe into the absorber where it is met by a shower of water practically free of ammonia coming through a pipe, and passing over the discs in the absorber. This water, which, by its gravity, has flowed from the generator to the absorber through a pipe, readily absorbs all the ammonia in the gas mixture. The hydrogen, thus freed of ammonia, assumes thereafter the total pressure in the upper part of the absorber. The light hydrogen, thus released, naturally rises, and thereby again finds its way into the evaporator. Consequently, the hydrogen rises in the absorber and sinks in the evaporator, where it is again mixed with ammonia vapor, and in this way a continuous circulation of hydrogen between these two vessels is maintained. No hydrogen can remain in the generator while the apparatus is working as it would be expelled by the ammonia vapor.

The return of the strong absorption liquid, from the bottom of the absorber to the generator, is provided for in a very simple way. A pipe acts as an effective "thermo-syphon," by means of which the strong liquid is automatically transferred back into the upper part of the generator.



FRONT VIEW OF COOLING UNIT

The heat supplied not only lifts the liquid from the level in the absorber to the higher level in the generator, but also again releases the ammonia from the water to pursue its cycle.

It will be noticed that the weak solution when leaving the lower part of the generator is practically free from ammonia on account of the high temperature prevailing.

The two pipes located between the condenser and the generator, the one being placed inside the

other, act as a heat exchanger on the counterflow principle. By means of this the hot, weak liquid, which flows from the bottom of the generator into the absorber, is pre-cooled by the comparatively cold, strong liquid that flows from the absorber to the thermo-syphon. This solution is at the same time pre-heated before entering the generator.

In a similar manner the heat exchanger is interposed between rectifier and absorber and the evaporator, where the cold ammonia hydrogen gas coming from the evaporator is warmed up by the hot ammonia coming from the rectifier and the hot hydrogen coming from the absorber.

The application of a heat exchanger and an efficient insulation of same as well as the generator leaves little room for thermal losses.

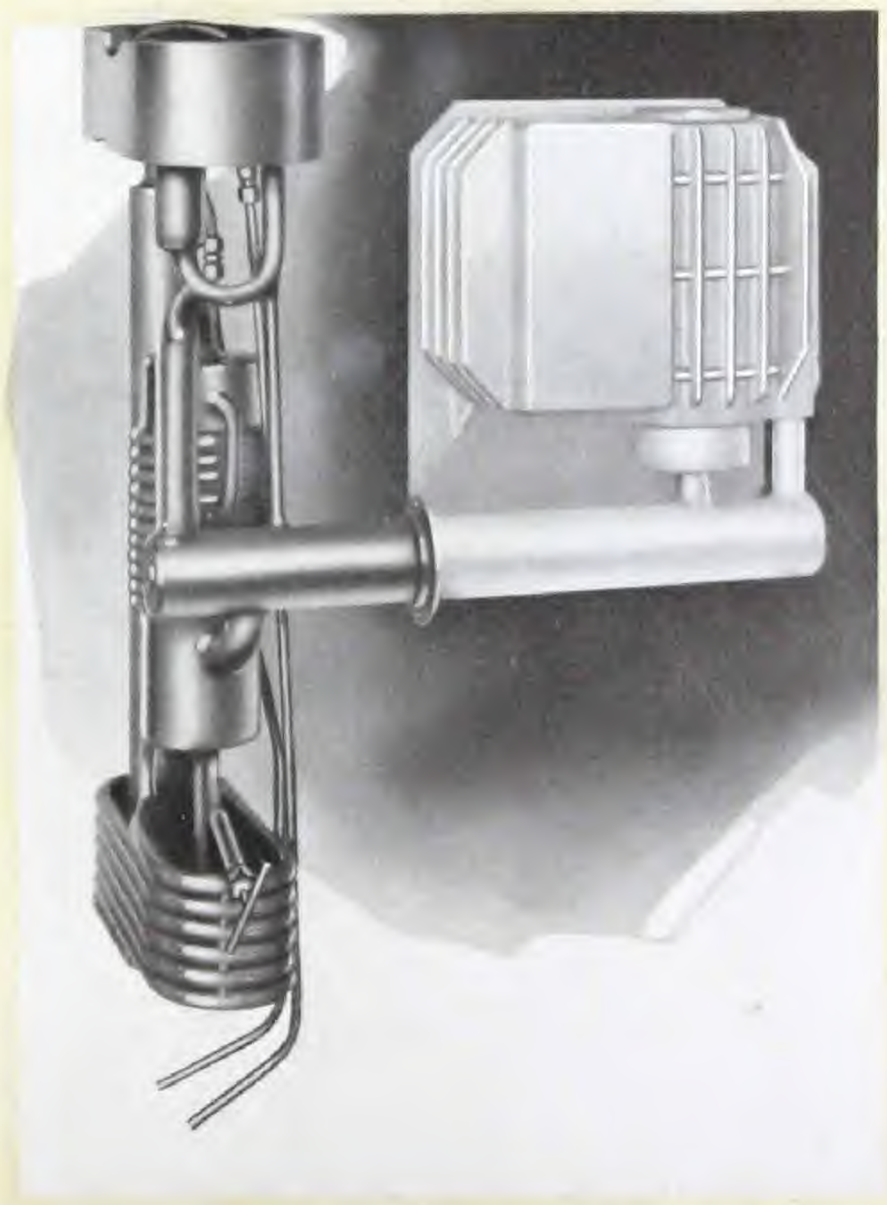
HERMETICALLY SEALED

The unit, before being charged with ammonia, distilled water and hydrogen, is given a careful air and hydraulic test under the most rigid factory supervision and after being charged is hermetically sealed by welding. The original charge does not have to be renewed, as there is no possibility of any leakage.

The refrigerator is equipped with a thermostatic safety burner which automatically shuts off the gas supplied if for any reason the supply is interrupted. The gas consumption to operate the unit is very low, which will result in extremely low cost of refrigeration.

One of the features of the refrigerator is that the operation involves absolutely no danger even if the condenser water supply should be interrupted for any length of time. Inasmuch as there are no moving parts, and being rigidly constructed, no servicing is necessary.

The refrigerator cabinet is a



REAR VIEW OF COOLING UNIT

steel box of approximately 6½ cubic feet food capacity, finished with several coats of duco over baked white lacquer. The cooling section inside the box is of cast aluminum having five trays, with a capacity of fifty cubes. The hardware is of the best brass, nickel-plated. The box is insulated with three inches of high-grade corkboard thus bringing the thermal losses and operating costs down to a minimum. The shelves consist of tinned grids, permitting free circulation of air in the box.

ELECTROLUX SERVEL CORPORATION

51 East Forty-second Street ~ New York City

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